CERL PEPR Program
(Process Energy and Pollution Reduction)

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Report Documentation Page

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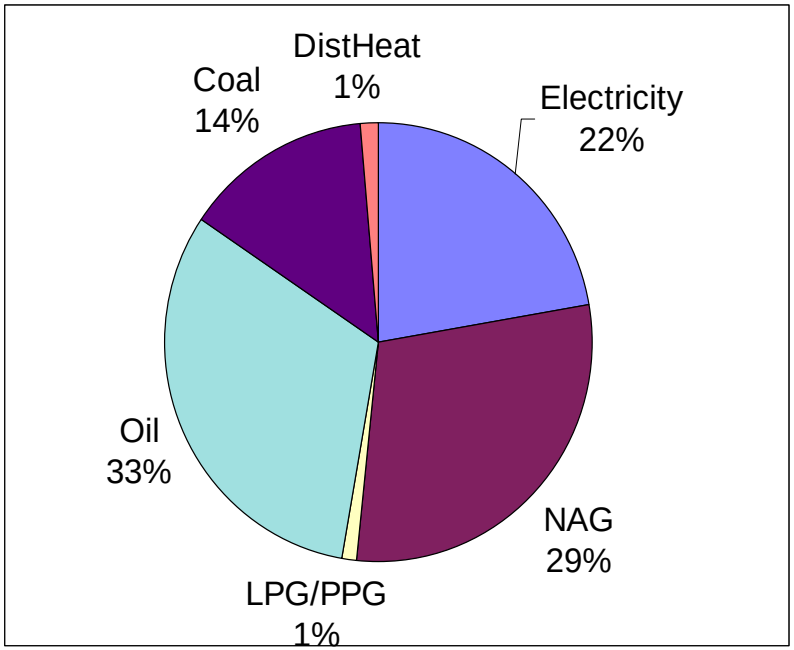
Background

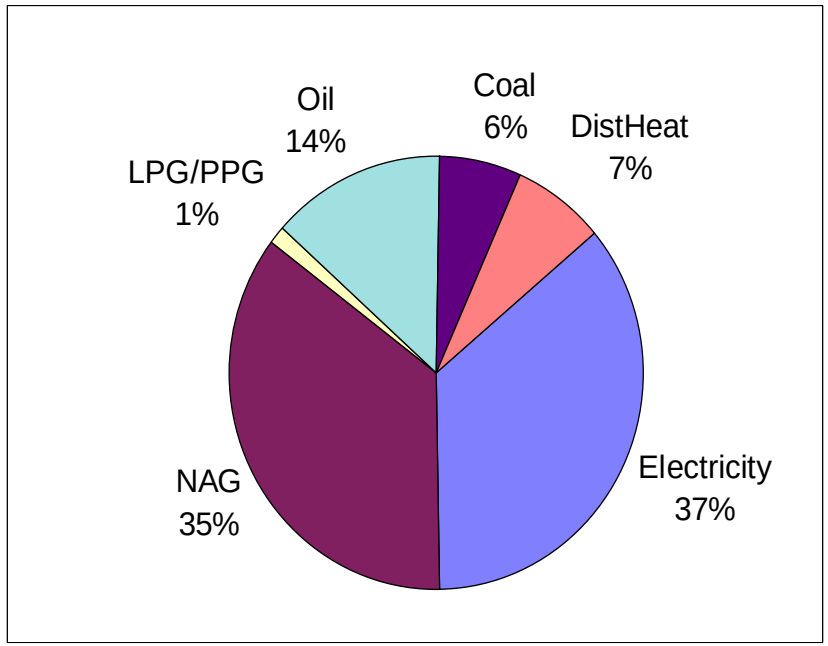
- Industry accounts for 36% of US energy ($100B/yr)
- DoD spends $3B/yr, $280M/yr at industrial facilities
- Process energy is reported on a voluntary basis
- AMC installations consume about 13 TBtu/yr for industrial processes, costing $72M/yr
- Studies show that 20% reduction is possible
- However, it has not been very effective in DoD due to the lack of an incentive structure
- Most of the industrial facilities are GOCO

Army Reported Energy Usage

FY 85 – 132 TBtu



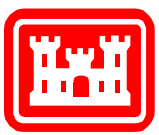
FY02 – 82 TBtu



- **AMC installations consume about 13 TBtu/yr for industrial processes, costing $72M/yr**

DoD Policy Requirements

- **ENERGY:** Executive Order 13123
  - Increase Industrial Efficiency 20% (1990 to 2005)
  - Increase Industrial Efficiency 25% (1990 to 2010)
  - Implement water conservation measures
- **COMPLIANCE:** Executive Order 12856
  - Promote Renewable Energy Technology
  - 50% Reduction in Toxic Pollutant Releases
- **POLLUTION PREVENTION:** Executive Order 12873
  - Incorporate Waste Prevention and Recycling
  - Use ‘Environmental Preferable’ Products/Services
  - Procurement Guides to Incorporate EPA Guidance



What Is CERL Doing for the Army in Process Energy Optimization?

Identify and Demonstrate New opportunities for Army Process Energy and Pollution Reduction (PEPR) Through:

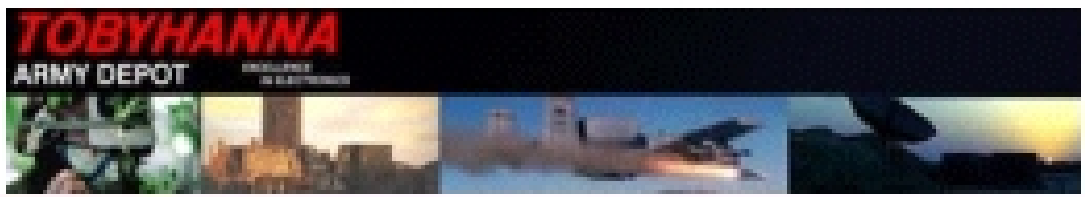
- **New Technologies**
- **Improved Systems and Operational Modifications**

Emphasis is placed on implementing changes that can be applied to numerous military installations with significant industrial activities

Our Customers

Watervliet Arsenal

Pine Bluff Arsenal



US Army Corps of Engineers

Engineer Research & Development Center

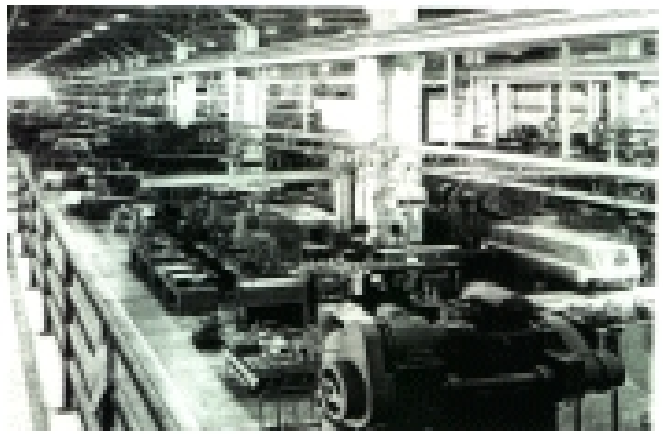
Recent ERDC-CERL Energy/Environment Projects with AMC

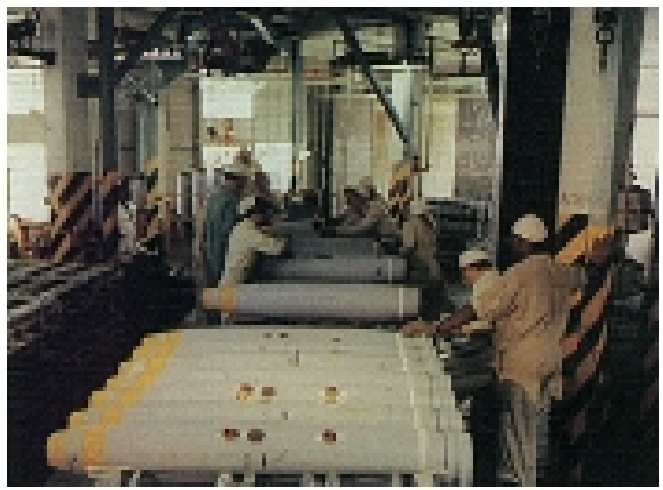
- **Energy**
  - **Process Optimization Assessment**
    - PBA, WVA, ANAD, TYAD
  - **Heating System Evaluation**
    - PICA, ARL
  - **Low NOx Boiler**
    - WVA
  - **Compressed Air System Audit**
    - APG, CCAD, CEGA, LCAAP, LSAAP, PBA, PICA, RIA, RSA, SIAD, WVA
  - **PEPR Analysis Program & Process Optimization Guide**

- **Environment**
  - **Hazardous Air Pollutant (HAP) Control**
    - ANAD, WVA
  - **Acid Mass Balance & Acidic Wastewater Reduction**
    - Radford AAP
  - **Methylene Control**
    - ANAD
  - **Convert Oil-based to Water-based Lubricant for Forging Operation**
    - Scranton AAP
  - **Pinkwater Treatment**
    - McAlester AAP

Typical DoD Processes

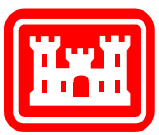
- Metal working: cutting, welding, machining, heat treating
- Spray painting & de-painting
- Electroplating
- Load, assemble & pack (LAP)
- Explosives/propellants production
- Steam systems
- Compressed air systems
- Motor/engine testing & repair





Major Cost Issues

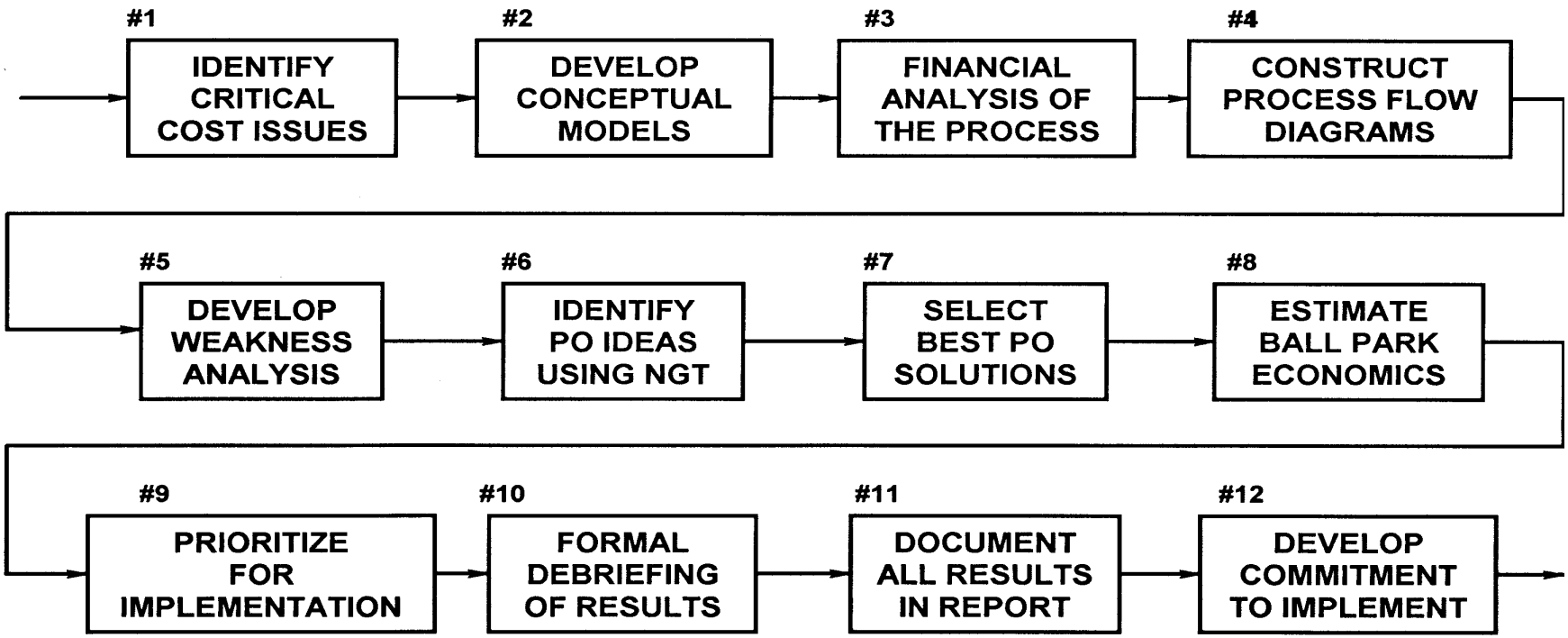
- Capacity Utilization: Bottlenecks
- Material Utilization: Off-Spec, Scrap, Rework
- Labor: Productivity, Planning/Scheduling
- Energy: Steam, Electricity, Compressed Air
- Waste: Air, Water, Solid, Hazardous
- Equipment: Outdated or State-of-the-Art



Process Optimization

- Extends conventional energy & environmental auditing to production/maintenance processes
- Uses a 12-step methodology and includes all major cost issues
- Financially audits the industrial process
- Links process changes to the “Bottom-line”

FIGURE 1: TWELVE STEPS OF THE PO METHODOLOGY



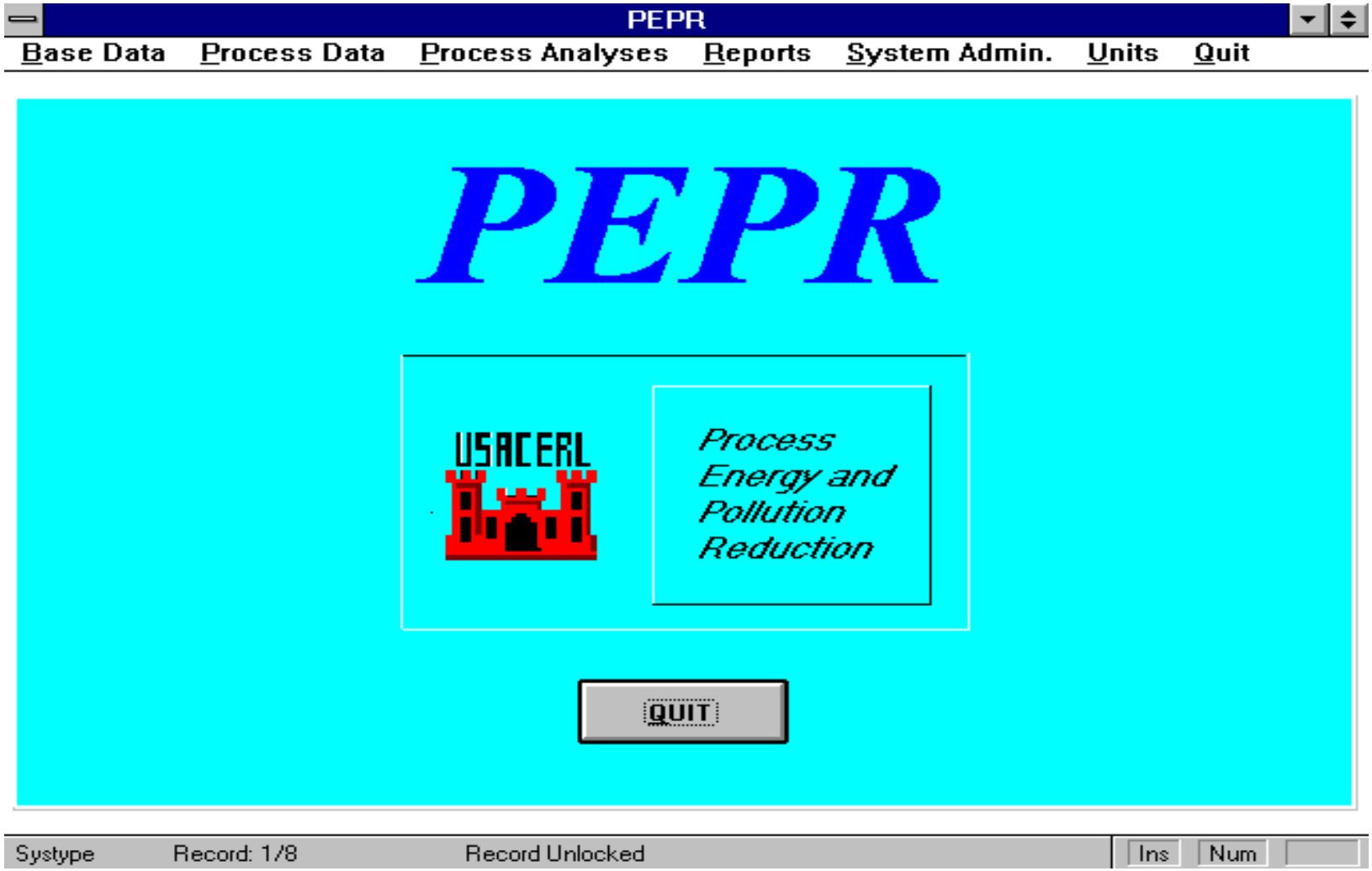
Process Energy & Pollution Reduction

(PEPR) an Analysis Model

- Builds process database
- Constructs process flow diagram
- Estimates process energy & emissions
- Suggests innovation techniques
- Calculates SIR and PB period
- Provides technical reference & unit conversion
- Screens DoD industrial operations
- Supports technology transfer

Case Examples Contained in PEPR

- Heat Treating
- Spray Painting
- Electroplating
- A Load, Assemble and Pack Line (LAP)
- Explosives Production
- Steam/Hot Water Distribution System
- Compressed Air Distribution System


PEPR
Base Data
Process Data
Process Analyses
Reports
System Admin.
Units
Quit
PEPR
USACERL
Process
Energy and
Pollution
Reduction
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Systype
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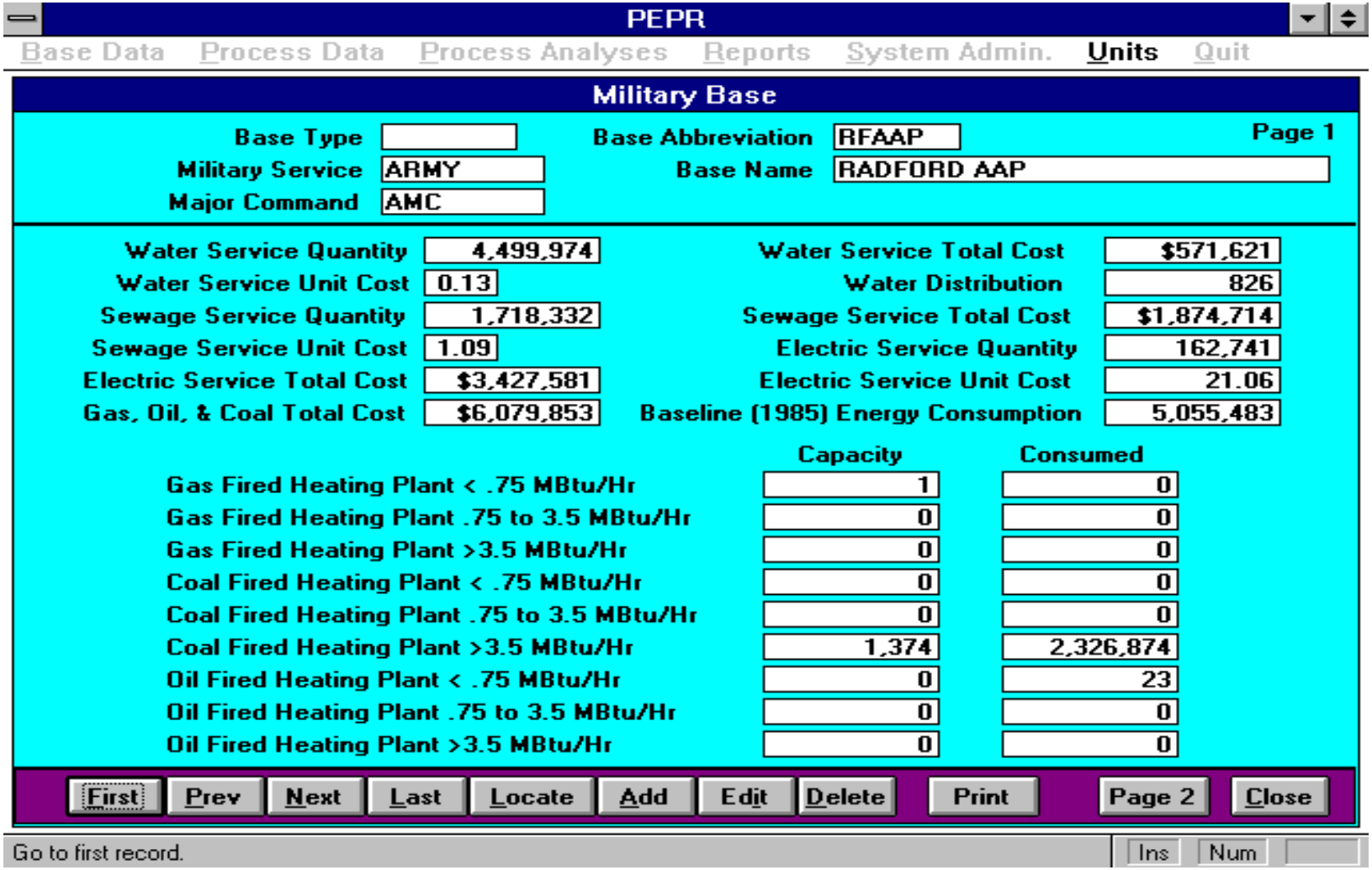
PEPR
Base Data
Process Data
Process Analyses
Reports
System Admin.
Units
Quit
Military Base
Page 1
Base Type
Base Abbreviation
RFAAP
Military Service
ARMY
Base Name
RADFORD AAP
Major Command
AMC
Water Service Quantity
4,499,974
Water Service Total Cost
$571,621
Water Service Unit Cost
0.13
Water Distribution
826
Sewage Service Quantity
1,718,332
Sewage Service Total Cost
$1,874,714
Sewage Service Unit Cost
1.09
Electric Service Quantity
162,741
Electric Service Total Cost
$3,427,581
Electric Service Unit Cost
21.06
Gas, Oil, & Coal Total Cost
$6,079,853
Baseline (1985) Energy Consumption
5,055,483
Capacity
Consumed
Gas Fired Heating Plant < .75 MBtu/Hr
1
0
Gas Fired Heating Plant .75 to 3.5 MBtu/Hr
0
0
Gas Fired Heating Plant >3.5 MBtu/Hr
0
0
Coal Fired Heating Plant < .75 MBtu/Hr
0
0
Coal Fired Heating Plant .75 to 3.5 MBtu/Hr
0
0
Coal Fired Heating Plant >3.5 MBtu/Hr
1,374
2,326,874
Oil Fired Heating Plant < .75 MBtu/Hr
0
23
Oil Fired Heating Plant .75 to 3.5 MBtu/Hr
0
0
Oil Fired Heating Plant >3.5 MBtu/Hr
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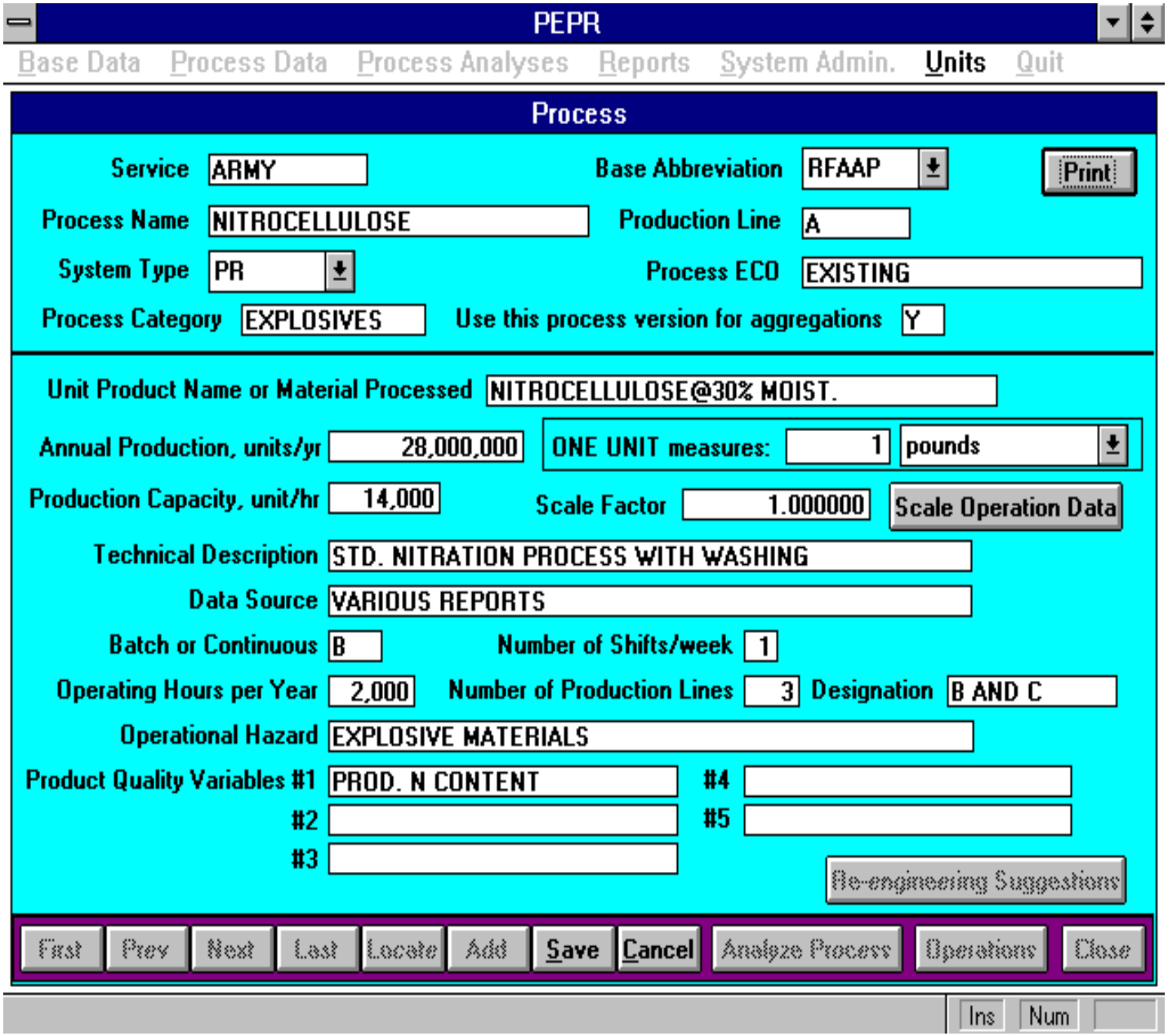
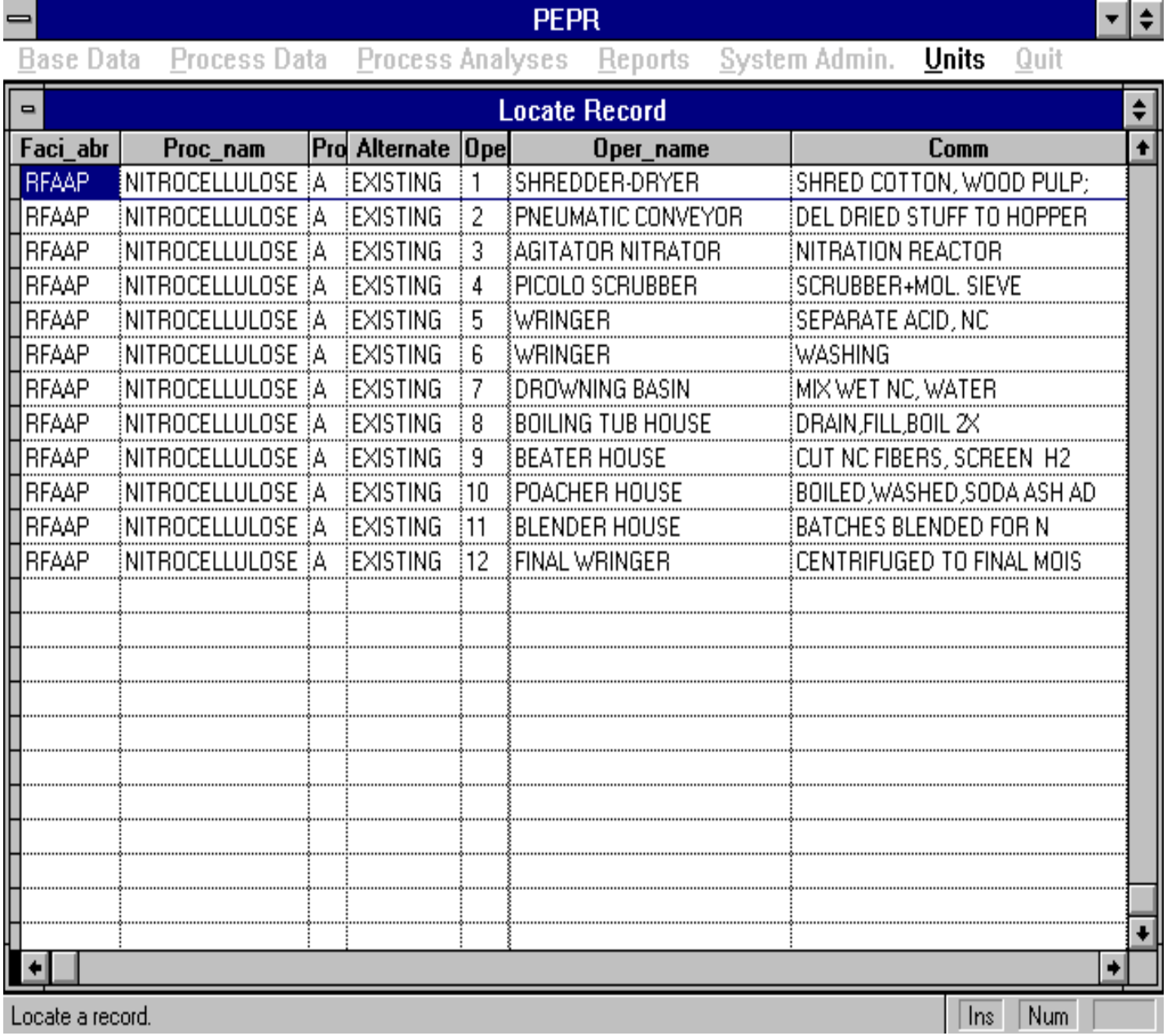

PEPR
Base Data
Process Data
Process Analyses
Reports
System Admin.
Units
Quit
Process
Service
ARMY
Base Abbreviation
RFAAP
Print
Process Name
NITROCELLULOSE
Production Line
A
System Type
PR
Process ECO
EXISTING
Process Category
EXPLOSIVES
Use this process version for aggregations
Y
Unit Product Name or Material Processed
NITROCELLULOSE@30% MOIST.
Annual Production, units/yr
28,000,000
ONE UNIT measures:
1
pounds
Production Capacity, unit/hr
14,000
Scale Factor
1.000000
Scale Operation Data
Technical Description
STD. NITRATION PROCESS WITH WASHING
Data Source
VARIOUS REPORTS
Batch or Continuous
B
Number of Shifts/week
1
Operating Hours per Year
2,000
Number of Production Lines
3
Designation
B AND C
Operational Hazard
EXPLOSIVE MATERIALS
Product Quality Variables #1
PROD. N CONTENT
#2
#3
#4
#5
Re-engineering Suggestions
First
Prev
Next
Last
Locate
Add
Save
Cancel
Analyze Process
Operations
Close
Ins
Num


PEPR
Base Data Process Data Process Analyses Reports System Admin. Units Quit
Locate Record
Faci_abr Proc_nam Pro Alternate Ope Oper_name Comm
RFAAP NITROCELLULOSE A EXISTING 1 SHREDDER-DRYER SHRED COTTON, WOOD PULP;
RFAAP NITROCELLULOSE A EXISTING 2 PNEUMATIC CONVEYOR DEL DRIED STUFF TO HOPPER
RFAAP NITROCELLULOSE A EXISTING 3 AGITATOR NITRATOR NITRATION REACTOR
RFAAP NITROCELLULOSE A EXISTING 4 PICOLO SCRUBBER SCRUBBER+MOL. SIEVE
RFAAP NITROCELLULOSE A EXISTING 5 WRINGER SEPARATE ACID, NC
RFAAP NITROCELLULOSE A EXISTING 6 WRINGER WASHING
RFAAP NITROCELLULOSE A EXISTING 7 DROWNING BASIN MIX WET NC, WATER
RFAAP NITROCELLULOSE A EXISTING 8 BOILING TUB HOUSE DRAIN,FILL,BOIL 2X
RFAAP NITROCELLULOSE A EXISTING 9 BEATER HOUSE CUT NC FIBERS, SCREEN H2
RFAAP NITROCELLULOSE A EXISTING 10 POACHER HOUSE BOILED,WASHED,SODA ASH AD
RFAAP NITROCELLULOSE A EXISTING 11 BLENDER HOUSE BATCHES BLENDED FOR N
RFAAP NITROCELLULOSE A EXISTING 12 FINAL WRINGER CENTRIFUGED TO FINAL MOIS
Locate a record.
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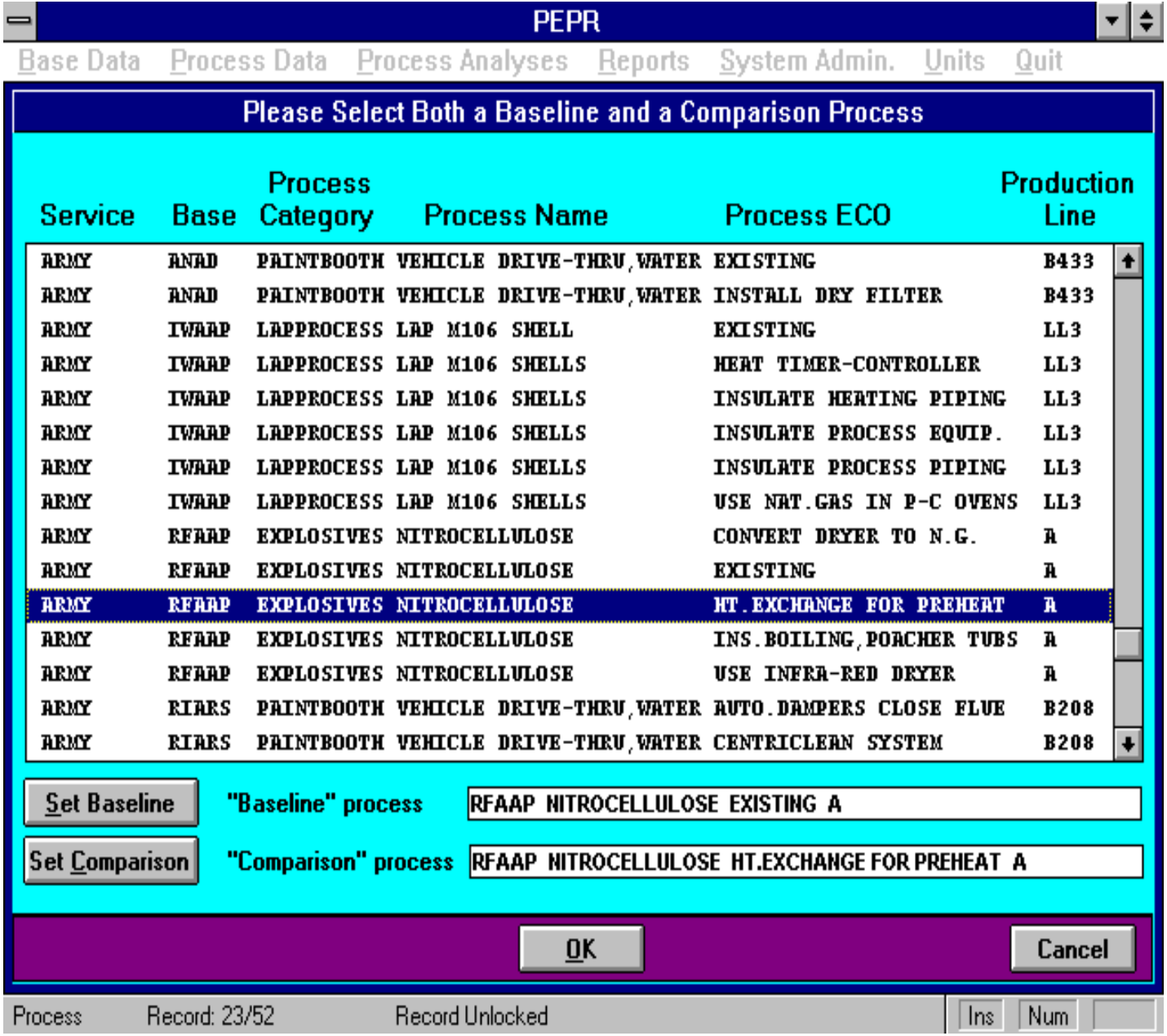
PEPR
Base Data
Process Data
Process Analyses
Reports
System Admin.
Units
Quit
Please Select Both a Baseline and a Comparison Process
Service
Base
Process Category
Process Name
Process ECO
Production Line
ARMY ANAD PAINTBOOTH VEHICLE DRIVE-THRU,WATER EXISTING B433
ARMY ANAD PAINTBOOTH VEHICLE DRIVE-THRU,WATER INSTALL DRY FILTER B433
ARMY IWAAP LAPPROCESS LAP M106 SHELL EXISTING LL3
ARMY IWAAP LAPPROCESS LAP M106 SHELLS HEAT TIMER-CONTROLLER LL3
ARMY IWAAP LAPPROCESS LAP M106 SHELLS INSULATE HEATING PIPING LL3
ARMY IWAAP LAPPROCESS LAP M106 SHELLS INSULATE PROCESS EQUIP. LL3
ARMY IWAAP LAPPROCESS LAP M106 SHELLS INSULATE PROCESS PIPING LL3
ARMY IWAAP LAPPROCESS LAP M106 SHELLS USE NAT.GAS IN P-C OVENS LL3
ARMY RFAAP EXPLOSIVES NITROCELLULOSE CONVERT DRYER TO N.G. A
ARMY RFAAP EXPLOSIVES NITROCELLULOSE EXISTING A
ARMY RFAAP EXPLOSIVES NITROCELLULOSE HT.EXCHANGE FOR PREHEAT A
ARMY RFAAP EXPLOSIVES NITROCELLULOSE INS.BOILING,POACHER TUBS A
ARMY RFAAP EXPLOSIVES NITROCELLULOSE USE INFRA-RED DRYER A
ARMY RIARS PAINTBOOTH VEHICLE DRIVE-THRU,WATER AUTO.DAMPERS CLOSE FLUE B208
ARMY RIARS PAINTBOOTH VEHICLE DRIVE-THRU,WATER CENTRICLEAN SYSTEM B208
Set Baseline
"Baseline" process
RFAAP NITROCELLULOSE EXISTING A
Set Comparison
"Comparison" process
RFAAP NITROCELLULOSE HT.EXCHANGE FOR PREHEAT A
OK
Cancel
Process
Record: 23/52
Record Unlocked
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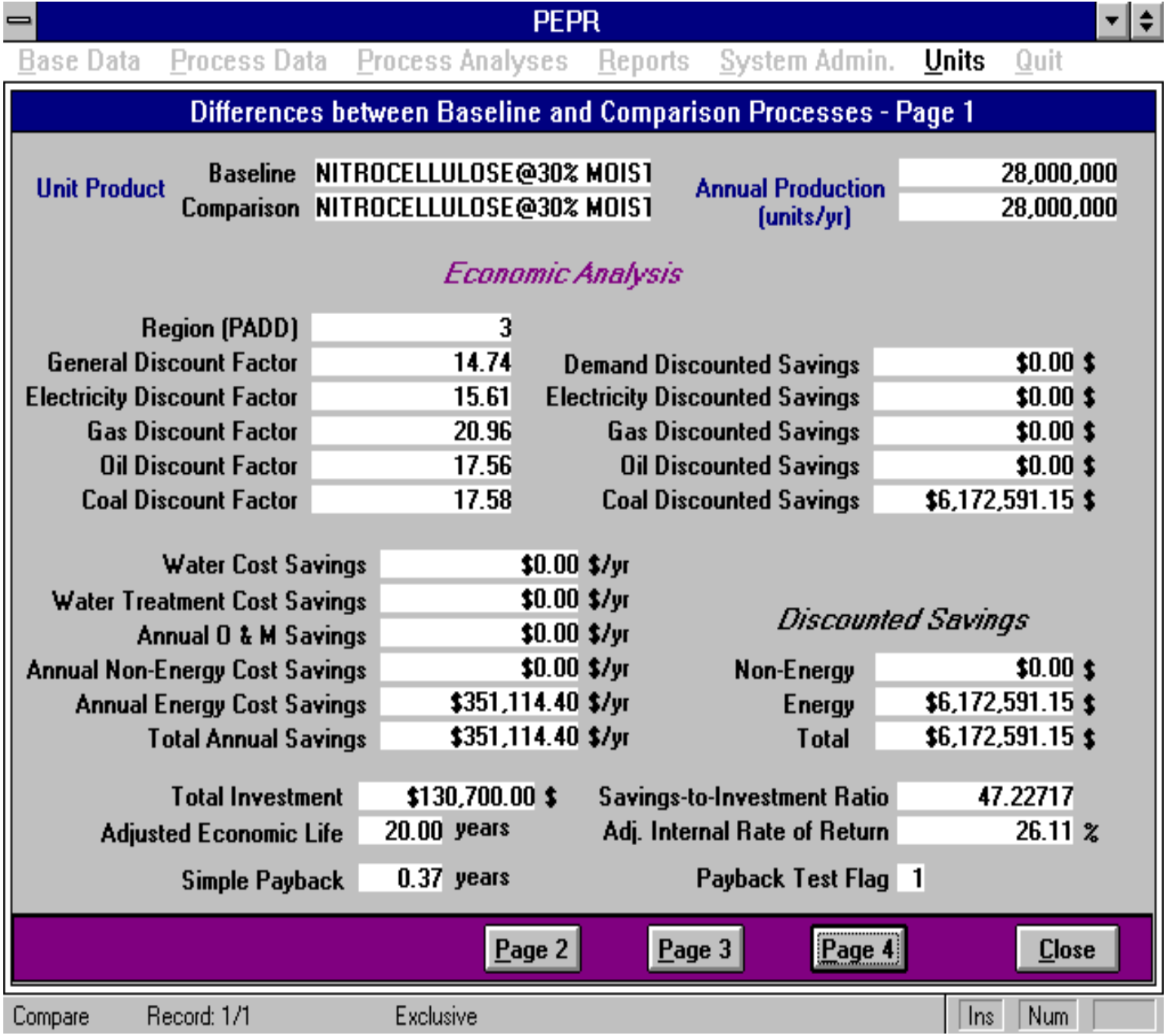
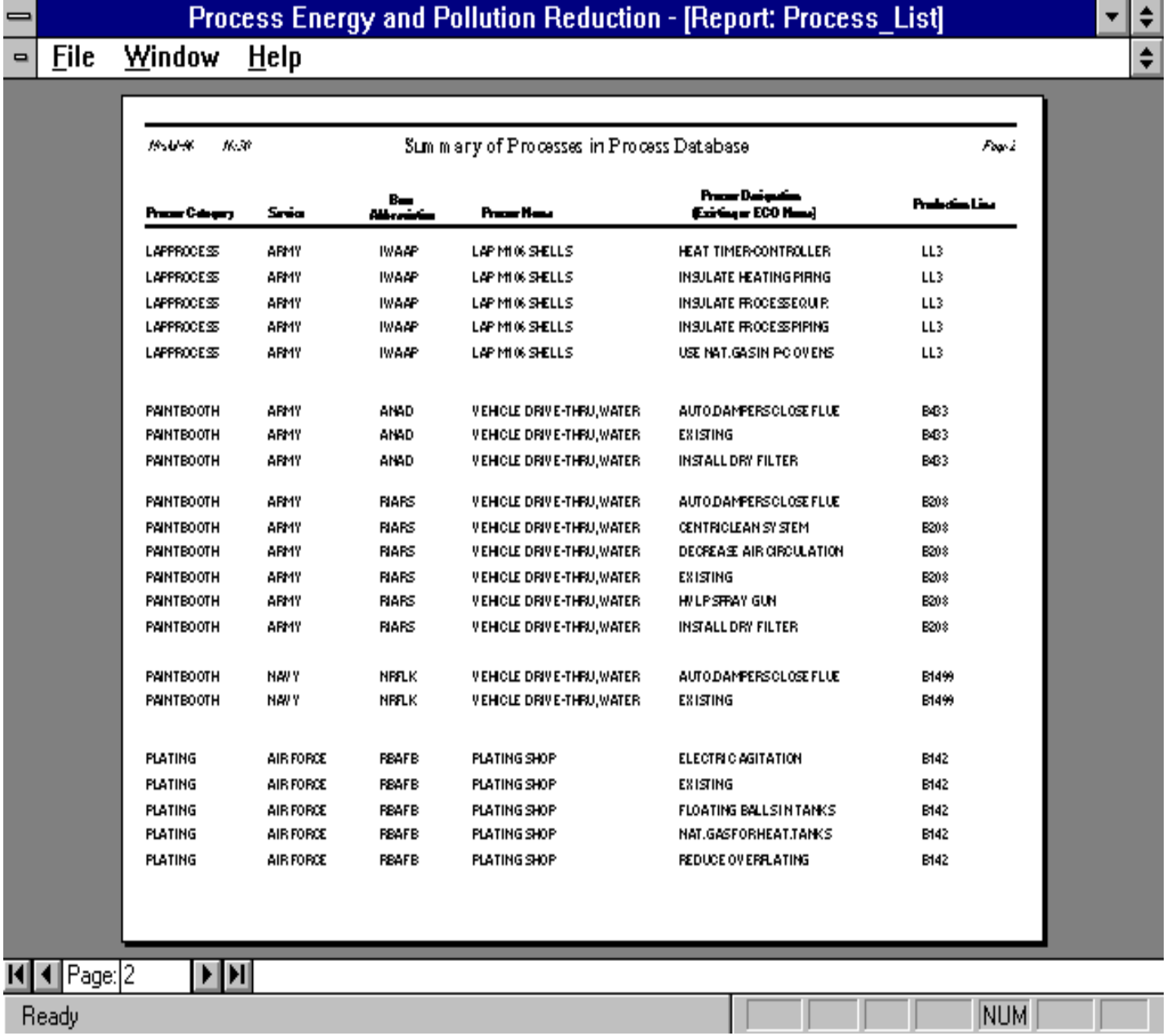
Num



US Army Corps of Engineers

Engineer Research and Development Center



Process Category	Service	Base Abbreviation	Process Name	Process Designation (Existing or ECO Name)	Production Line
LAPPROCESS	ARMY	IWAAP	LAP MIX SHELLS	HEAT TIMER/CONTROLLER	LL3
LAPPROCESS	ARMY	IWAAP	LAP MIX SHELLS	INSULATE HEATING PIPING	LL3
LAPPROCESS	ARMY	IWAAP	LAP MIX SHELLS	INSULATE PROCESS EQUIP.	LL3
LAPPROCESS	ARMY	IWAAP	LAP MIX SHELLS	INSULATE PROCESS PIPING	LL3
LAPPROCESS	ARMY	IWAAP	LAP MIX SHELLS	USE NAT.GAS IN PC OVENS	LL3
PAINTBOOTH	ARMY	ANAD	VEHICLE DRIVE-THRU,WATER	AUTO.DAMPERS CLOSE FLUE	B403
PAINTBOOTH	ARMY	ANAD	VEHICLE DRIVE-THRU,WATER	EXISTING	B403
PAINTBOOTH	ARMY	ANAD	VEHICLE DRIVE-THRU,WATER	INSTALL DRY FILTER	B403
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	AUTO.DAMPERS CLOSE FLUE	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	CENTRICLEAN SYSTEM	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	DECREASE AIR CIRCULATION	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	EXISTING	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	HVLP SPRAY GUN	B208
PAINTBOOTH	ARMY	RIARS	VEHICLE DRIVE-THRU,WATER	INSTALL DRY FILTER	B208
PAINTBOOTH	NAVY	NRFLK	VEHICLE DRIVE-THRU,WATER	AUTO.DAMPERS CLOSE FLUE	B1499
PAINTBOOTH	NAVY	NRFLK	VEHICLE DRIVE-THRU,WATER	EXISTING	B1499
PLATING	AIR FORCE	FBAFB	PLATING SHOP	ELECTRIC AGITATION	B142
PLATING	AIR FORCE	FBAFB	PLATING SHOP	EXISTING	B142
PLATING	AIR FORCE	FBAFB	PLATING SHOP	FLOATING BALLS IN TANKS	B142
PLATING	AIR FORCE	FBAFB	PLATING SHOP	NAT.GAS FOR HEAT.TANKS	B142
PLATING	AIR FORCE	FBAFB	PLATING SHOP	REDUCE OVERPLATING	B142

Energy Savings and Investments for All DoD Process-Oriented Bases

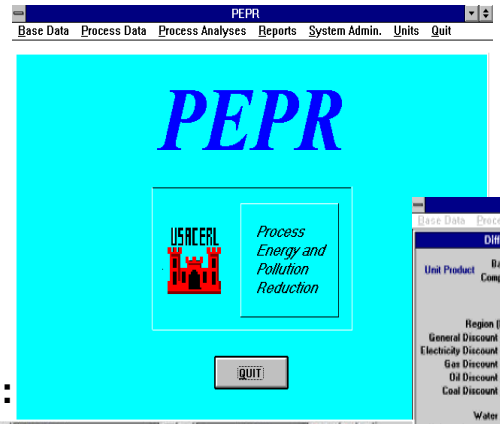
	Annual Use MBtu	Identified Savings		Identified Investments	
		% Annual Use	MBtu/yr	$/Annual MBtu	$M
Thermal Energy					
AMC Bases (29)	13,328,980	22.8	3,039,007	5.22	15.86
AEDC + ALCs (5)	6,163,819	14.2	875,262	3.82	3.34
Naval Bases	10,892,704	8.7	947,664	11.43	10.84
Electricity					
AMC Bases (29)	4,997,411	8.4	419,783	20.33	8.53
AEDC + ALCs (5)	7,384,623	2.1	155,077	33.35	5.17
Naval Bases	6,150,884	3.7	227,582	16.52	3.76
Total Energy					
AMC Bases (29)	18,326,391	19	3,458,790	7.05	24.39
AEDC + ALCs (5)	13,548,442	8	1,030,339	8.26	8.51
Naval Bases	17,043,588	7	1,175,246	12.42	14.60
Totals	48,918,421	12	5,664,375	8.39	47.50

Pollution Abatement Associated with
Energy Savings and Investments for All DoD Process-Oriented Bases

	SO_x Abated, tons/yr	NO_x Abated, tons/yr	CO Abated, tons/yr	CO_2 Abated, tons/yr
Thermal Energy				
AMC Bases (29)	2,528.42	584.53	193.95	254,443
AEDC+ALC Bases (5)	3.09	60.22	14.88	50,555
Naval Bases	492.26	133.96	39.36	73,929
Electricity				
AMC Bases (29)	1,198.95	244.65	86.45	87,604
AEDC+ALC Bases (5)	426.53	90.36	31.64	33,817
Naval Bases	276.60	62.08	19.94	28,121
Total Energy				
AMC Bases (29)	3,727.37	829.18	280.40	342,047
AEDC+ALC Bases (5)	428.62	150.58	46.52	84,372
Naval Bases	768.86	196.04	59.30	102,050
Totals	4,924.85	1,175.80	386.22	528,470

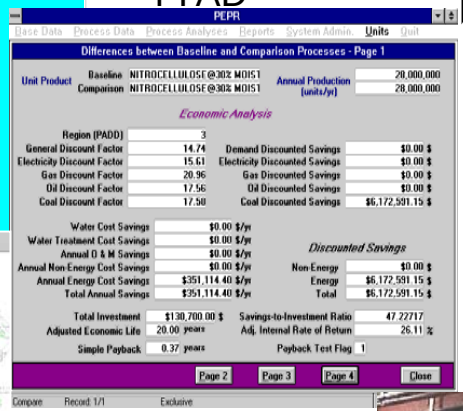
ERDC-CERL Support to Industrial Energy

Research for decision support tools



PEPR audits:
- PBA
- WVA
- ANAD
- TYAD

Average 20% + increase in process energy efficiency & reduced O&M costs



Technology demonstration projects

HEATER/Heatmap:
- PICA
- ARL-Adelphi
- and troop installations

Estimate <u>life cycle cost</u> of repair, replacement, and upgrade options.

Low NOx Boiler Demo's:
- WVA
- and 3 troop installations

NGEDAC Demo's:
- PICA
- WVA
- SIAD

Minimizes greenhouse pollutants

Average total energy savings per plant = ~44%

Industrial Energy Optimization

Action	Where	When
PO Workshop & Audits	Pine Bluff Arsenal, AR	June 94 & Aug 96
PO Audit	Anniston Army Depot, AL	July 1995
PEPR Software	CERL	May 1996
PO Workshop & Audits	Watervliet Arsenal, NY	Feb 1999
PO Guide	CERL	May 1999
PEPR Enhancement	CERL	June 2000
PO Workshop & Audit	Tobyhanna Army Depot, PA	June 2002
PO Audit	Ft. Leonard Wood, MO	April 2003
PO Audit	Ft. Carson, CO	May 2003

Process Optimization Assessment at Ft. Leonard Wood and Ft. Carson

The 5-Day Audit Covered the Following Industrial Processes:

(1) Central heating plants

(2) Laundry

(3) Painting and Media blasting

(4) Engine overhaul and Vehicle repair

We Identified Opportunities, for each Process, to:

(1) Improve Performance

(2) Increase Efficiency and to Reduce Energy and Emissions including Air, Water and Solid Waste.

We Developed, for each Process:

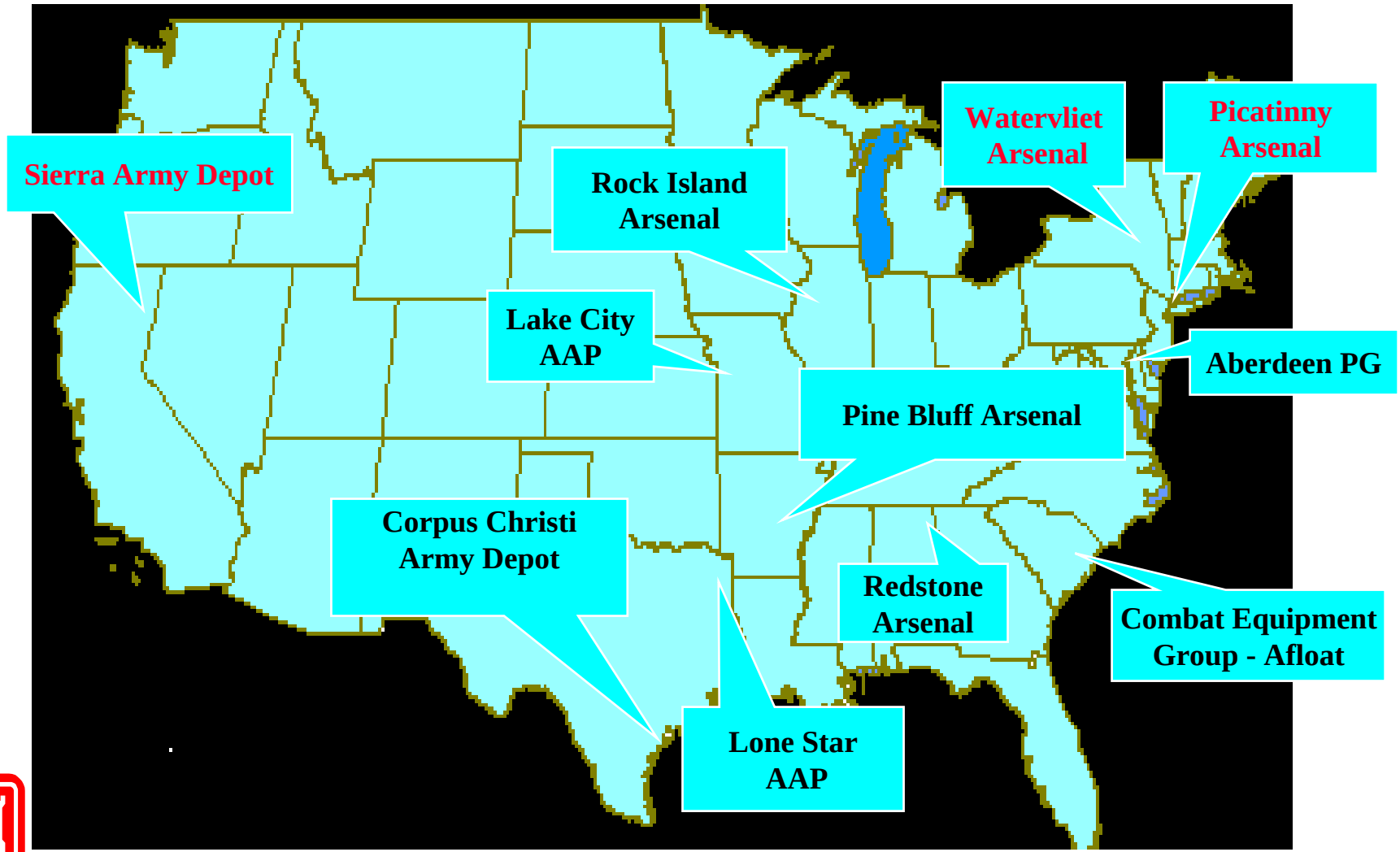
(1) Preliminary Capital Investments

(2) Potential Cost Savings from Process Optimization and Improvement

Process Optimization Assessment Results

Army Base	Fort Leonard Wood	Fort Carson
# of Post Wide ECM	5	10
# of Heating Plant ECM	11	9
# of Laundry ECM	4	N/A
# of Maintenance Complex ECM	6	10
Total # of ECMs	26	29
Savings	$1,963,275	$2,117,250
Investment	$1,929,300	$1,250,300
Simple Payback	1 yr.	0.6 yr

NGEDAC Demonstrations



US Army Corps of Engineers

Engineer Research and Development Center

ERDC/CERL Technical Reports

- **“Energy Conservation and Air Toxic Compliance Plan for DoD Industrial Facilities”**
- **“Level I Process Energy Review and PEPR Workshop at Pine Bluff Arsenal”**
- **“Level II Audit of White Phosphorus Dry-Fill Process at Pine Bluff Arsenal”**
- **“Level II Audit of Smoke Grenade Manufacturing Process at Pine Bluff Arsenal”**
- **"Development of Process Energy and Pollution Reduction Analysis Tool”**
- **"Identification of PEPR Opportunities at DoD Industrial Facilities”**
- **"Process Optimization Guide for Military Manufacturing and Maintenance Facilities”**
- **"PEPR Level I Review at the Watervliet Arsenal”**
- **“Applications Guide for Compressed Air Systems”**
- **“Compressed Air System Survey at Army Industrial Facilities”**
- **“Demonstration of Natural Gas Engine Driven Air Compressor at Army Industrial Facilities”**
- **“Process Energy Optimization Level I Review, Tobyhanna Army Depot, PA”**
- **“ Process Optimization Assessment, Fort Leonard Wood, MO and Fort Carson, CO”**

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Summary and Conclusions

- **Energy Can Be Used to Improve Process Performance, Directly Contributing to the Business Bottom Line.**
- **Energy is an Important Solution Tool. However, Rethinking and Optimizing All Inputs to the Process Systems are the Total Answer.**
- **The 2-5 Day POA Provides the Change, Focus and Speed to Achieve Significantly Faster and Far Greater Profitability than Other Traditional Energy Audit Approaches.**
- **The PEPR Program Facilitate Data Collection, Analysis and Technology Transfer**

Thank You !